

Executive Summary

Introduction:

This study's objective was to establish manual water level staff gages below the Fife Brook Hydroelectric Project (Project) on the mainstem Deerfield River, as well as install data logging equipment to collect continuous data from a previously installed water level sensor. The overall study goal was to provide a means to monitor streamflow below the Project in an effort to assure all river users, the project owners, and regulatory agencies that prescribed minimum and other regulatory flows are being maintained.

Manual Staff Gage Installation

At the location of a discontinued USGS gage (Deerfield River at Rowe, MA, Gage No. 01168151), below the Fife Brook Hydroelectric Project, a series of manual staff gages capable of measuring gage heights (streamflows) ranging from 1.60 feet (17.6 cubic feet per second [cfs]) to 8.42 feet (4,299 cfs) were installed. The manual staff gages will serve the following functions:

- An independent reference gage to indicate the water level or stage height in the river;
- When necessary, gage readings taken on the manual staff gage should be used to recalibrate the water level sensor; and
- A temporary substitute for the water level sensor if there is an equipment failure. The manual staff gages can be read as needed by local observers to continue the record of gage height during the malfunction.

Stage-Discharge Rating Curve Development

Continuous records of streamflow are computed by applying a stage-discharge rating curve developed for the site to measurements of stage height. Stage-discharge rating curves for gaging stations are usually determined by plotting measurements of streamflow (discharge) and gage height (stage). For this study, several stream discharge measurements were made to define a stage-discharge rating curve for this site. In terms of the prescribed minimum flow at the Fife Brook Hydroelectric Project, a gage height of 2.89 feet or greater is needed to meet or exceed the 125 cfs requirement.

Collection of Continuous Streamflow Data

An electronic datalogger was installed in conjunction with a pre-existing water level sensor, owned by USGen New England Inc. (USGen), to record gage heights at the site. This datalogger was programmed to convert the measured gage heights to streamflow using the stage-discharge relationship, and then store these readings in its memory. The water level sensing and data logging equipment are sheltered in a discontinued USGS gage house.

Volunteers were trained on the steps necessary to accurately read the manual staff gages installed at the site, as well as properly download gage height and streamflow information from the data logger. An MS Access database was developed to store the gage height readings collected by volunteers. The database is designed to automatically convert the gage heights to streamflow using the stage-discharge relationship, as well as calculate a series of statistics.

Recommendations

The following are recommendations to assist river users in continued monitoring of streamflow on the Deerfield River.

- It is recommended that the Deerfield River near West Deerfield, MA (Gage No. 01170000) USGS gage be used to monitor flows from the Station No. 2 project. This gage can be used to give a close approximation of the timing and magnitude of flow releases from Station No. 2. It was agreed that in lieu of installing a second manual staff gage at Bardwell Ferry, the resources allocated for this item were used to facilitate continuous streamflow monitoring below the Fife Brook Hydroelectric Project. The main purpose of the proposed Bardwell Ferry manual staff gage was to monitor flow releases from the Station No. 2 project, as the stream reach below the project is a high quality coldwater fishery. Bardwell Ferry and the Deerfield River near West Deerfield, MA (Gage No. 01170000) USGS gage are located approximately 2.5 miles and 4.4 miles below the Station No. 2 project, respectively.

The drainage area at Station No. 2 is 505 square miles, while the drainage area at the USGS gage is 557 square miles. Thus, 52 square miles of unregulated drainage area contributes flow to this stream reach, in addition to the flow releases from Station No. 2.

For a closer approximation of project flow releases, flow from the South River can be subtracted from the total flow measured at the Deerfield River near West Deerfield, MA USGS gage. Flow from the South River USGS gage, which enters the Deerfield River 0.4 miles upstream of the West Deerfield USGS gage, is measured by the South River near Conway, MA (Gage No. 01169900) USGS gage (see Figure 1). The drainage area measured by the South River USGS gage is approximately 24 square miles; thus the flow resulting from subtracting South River flow from flow measured at the West Deerfield USGS gage would reflect 28 square miles of unregulated drainage area between the project and the West Deerfield USGS gage.

- It is recommended that an annual survey of the gage reference marks, as well as the manual staff gage and water level sensor elevations be conducted so that any movement, settling, etc. can be noted and corrected. All reference marks and gage elevations are surveyed in at 0.01 feet accuracy. Streamflow measured at the Fife Brook Hydroelectric Project gage can become inaccurate if correct station survey levels are not maintained.
- It is recommended that streamflow measurements be conducted on an annual basis to either verify the accuracy of the stage-discharge rating curve or to follow changes (shifts) in the rating. Substantial sediment deposition or erosion near the area of a gage location can cause a shift in a stage-discharge rating curve. Shifts in the discharge rating reflect the fact that stage-discharge rating curves are not always permanent but vary from time to time, either gradually or abruptly. According to the USGS, if a streamflow measurement is within 5 percent of the streamflow discharge value indicated by the stage-discharge rating curve, the measurement is considered to verify the rating curve. However, if several consecutive measurements meet the 5-percent criterion, but they all plot on the same side of the defined segment of the stage-discharge rating curve, they may be considered to define a period of shifting control.